Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short Communication

Using serological studies to assess COVID-19 infection fatality rate in developing countries: A case study from one Colombian department

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ABSTRACT

This study describe the infection fatality rate (IFR) by COVID-19 by age groups in one department of Colombia. It used results from a serological survey to stablish a closer estimation of the true proportion of infected people. It found an overall IFR of 0.24% quite lower than the overall CFR (5.6%). We conclude that CFR severely overestimate the lethality of COVID-19 in developing areas.

The infection fatality rate (IFR) is a critical epidemiological parameter that allows assessment of the dynamics and virulence of any infectious agent and the quality of health services (Levin et al., 2020). There is still uncertainty about the true IFR of COVID-19 because detecting all infections and cases depends on the quality of surveillance and the number of tests available. Attempting to estimate IFR in developing countries is incredibly challenging because they have weaker surveillance systems coupled with a deficit of laboratories able to carry out molecular tests across the entire territory. There have been attempts to estimate IFR using serological estimates, but there are few serological studies from developing countries. In systematic reviews conducted by Ioannidis and Levin et al., only 6 developing countries had IFR estimates (Levin et al., 2020; Ioannidis, 2021).

By March 5, 2021, Colombia has been hit by 2 waves of COVID-19, reporting 2.2 million cases and 60 300 deaths (case fatality rate, CFR = 2.6%) (Instituto Nacional de Salud (INS), 2021). However, the actual number of infected people is unknown because of geographical differences in the surveillance system performance and laboratory capacities. Thus, Colombia lacks accurate estimates on IFR (Hurtado-Ortiz et al., 2020). So far, only 3 Latin American countries—Argentina, Brazil and Chile—have informed IFR from serological surveys (Ioannidis, 2021). In this short report, we attempt to fill that gap by estimating IFR from a population-based serological survey in one department of Colombia, Córdoba (Population = 1 785 000), which was carried out during the aftermath of the first peak of the pandemic (August–September 2020).

Methods to select participants and characteristics of serological tests used have been described elsewhere (Mattar et al., 2020). Briefly, 2447 people, >9 years old, were selected from randomly selected households from all neighborhoods in 6 cities of the department. Blood samples were taken after a consent format was signed, and sera were collected from native individuals from the Córdoba Department. Sera were tested at the Instituto de Investigaciones Biológicas del Trópico using INgezim COVID-19 DR test (Ingenasa, Eurofins Madrid, Spain), a dual recognition enzyme-linked immunosorbent assay, detecting semi-quantitatively total SARS-CoV-2 virus N-protein-specific antibodies (immunoglobulin (Ig)G, IgM, and IgA). The assay has a sensitivity (Se) of 93% and a specificity (Sp) of 95%. Prevalence data were adjusted by Se and Sp.

All COVID-19 deaths detected in the cities of the study between March 1 and October 9, 2020 (one week after the serological study)

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Table 1
SARS CoV 2 seroprevalence, lethality and mortality indicators by age group. Department of Cordoba, Colombia. September 2020.

Age range (years)	Sampled subjects	Prevalence n (%)	Adjusted prevalence	Population 2020[b]	Expected infections[a]	Deaths	% IFR (95% CI)	Confirmed cases Covid-19	% CFR (95% CI)	Mortality rate per 10^5 (95% CI)
10–14	45	25 (55.6)	58	161,194	93,492	1	0.001 (0.0003–0.005)	877	0.1 (0.006–0.6)	0.6 (0.03–3.0)
15–19	100	47 (47)	48	159,081	76,358	4	0.005 (0.002–0.01)	1,280	0.3 (0.1–0.7)	2.5 (0.8–6.0)
20–29	424	174 (41)	41	293,018	120,137	20	0.016 (0.009–0.02)	5,201	0.4 (0.2–0.6)	6.8 (4.3–10.4)
30–39	523	205 (39.2)	39	249,540	97,320	52	0.05 (0.04–0.07)	6,095	0.8 (0.6–1.1)	21.0 (15.7–27.0)
40–49	463	202 (43.6)	44	217,116	95,531	110	0.11 (0.09–0.14)	4,712	2.3 (1.9–2.8)	50.7 (42.0–61.0)
50–59	428	152 (35.5)	35	186,518	65,281	210	0.32 (0.28–0.37)	4,203	5.0 (4.4–5.7)	113.0 (98.4–129.0)
60–69	297	131 (44.1)	44	125,614	55,270	356	0.64 (0.58–0.71)	3,141	11.3 (10.3–12.5)	285.0 (256.4–315.6)
≥70	164	60 (36.6)	36	162,707	58,574	865	1.5 (1.4–1.6)	3,259	26.5 (25.0–28.0)	530.7 (496.2–567.0)
Total	2444	996 (40.8)		1,554,788	661,963	1,618	**0.24 (0.23–0.25)**	28,768	5.6 (5.3–5.9)	104.0 (100.0–109.0)

Bold value signify <0.005.
[a] Expected infections = (seropositivity*population 2020)/100.
[b] Population under 10 years old was excluded from the serological survey and consequently from these estimates.

were included in the analysis. Deaths, seropositive people, detected COVID-19 cases, and population size were disaggregated by the age groups shown in Table 1. The number of people infected was estimated by specific age groups, along with the 95% CIs, by multiplying the proportion of seropositive by the population size of the same group. Then, COVID-19 deaths (confirmed by PCR or antigen tests) were divided by the size of the population infected to obtain IFR by age group. CFR by age group was estimated by dividing deaths by the number of cases detected by the surveillance system, Table 1.

There were 1618 COVID-19 deaths during the study period for a CFR of 5.6%, IFR of 0.24% (for people aged ≥10) and mortality rate of 104 per 10^5. All estimates were lower among young people and increased substantially among the oldest age groups. The lowest IFR value was observed for people aged 10–14 years, 0.001%, and the highest among people aged ≥70 years, 1.5%. The overall ratio CFR:IFR was 23, but it was wider among the youngest people: 100 for children <15 years, decreasing to 25 for the age group 20–29 years and leveling off between 17 and 21.

To the authors' knowledge, ours is the first report in Colombia attempting to estimate IFR from a serological survey. It shows 2 important things: first, that CFR overestimates the lethality of COVID-19 and second, that the bias is differential by age groups. IFR is lower than CFR for every age group but especially for those under 25 years old. The surveillance system identified 1 in every 22 infected cases, but only 1 in 100 for children under 15 years old. The IFR obtained in this study raises an issue about the utility of CFR to assess the effectiveness of health services. By the time of the survey, Córdoba had twice the CFR of the country, 3.1%, but a sizable portion of the difference is explained by surveillance sensitivity and not by health care effectiveness.

One potential source of error of our study is that serological tests do not have 100% Se or Sp, so IFR may be overestimated. However, we adjusted the prevalence by Se and Sp, and there were no significant differences between adjusted and unadjusted values. Therefore, these results may guide the discussion about the right control measures that should be adopted to control future epidemic waves (Melnick and Ioannidis, 2020).

Ethical approval

The study protocol was approved by the research committee of the Institute of Tropical Biological Research of the University of Cordoba. Informed consent was obtained from all participants.

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Conflict of interest

None declared.

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